

frequency of this bacillus in the blood are quite parallel to what of late years we have been finding in the blood in cases of lobar pneumonia.

TREATMENT. In the treatment of this disease we have as yet no specific. The main hope of the future is that some successful serum will be obtained. Cantani²⁴ and Latapie²⁵ have produced serums against this infection, and in some cases these were thought to be of some value in experimental infections, but I am not aware that any serum has been used clinically.

Homologous vaccines should be given a trial when they can be obtained, especially in such cases as those reported by Horder and Smith. Thompson²⁶ and Barr²⁷ have recently reported good results with vaccines in several cases of streptococcic endocarditis with septicemia.

In the general management of these cases one may follow the methods in vogue in treating typhoid fever in regard to hygiene, rest in bed, diet, and hydrotherapy, though, as a rule, influenzal patients do not tolerate well the application of cold. Convalescence should be carefully managed. They need especially fresh air and nutritious food. It may take weeks or months before the patient is entirely recovered.

ACUTE PNEUMOCOCCIC MENINGITIS.

WITH THE REPORT OF A CASE SECONDARY TO EMPYEMA OF
THE FRONTAL SINUS.

By E. F. McCAMPBELL, M.D.,

ASSOCIATE PROFESSOR OF BACTERIOLOGY IN THE OHIO STATE UNIVERSITY,

AND

G. A. ROWLAND, M.D.,

ASSISTANT PHYSICIAN TO THE COLUMBUS STATE HOSPITAL, COLUMBUS, OHIO.

(From the Pathological Laboratory of the Columbus State Hospital, Columbus, Ohio.)

INFLAMMATIONS of the pia-arachnoid due to *Micrococcus pneumoniae* are not uncommon. Infections of the meninges with this bacterium are invariably fatal, and consequently the disease is of very great interest. Among 49,028 clinical cases of pneumonia, meningitis occurred in 206, or 0.24 per cent., and at necropsy meningitis was noted in 180 out of 4833 cases of pneumonia, or 3.5 per

²⁴ Zeit. f. Hyg., xlii, 504.

²⁵ AMER. JOUR. MED. SCI., 1909, cxxxviii, 169.

²⁶ C. R. Soc. Biol., lv, 1272.

²⁷ Lancet, February 23, 1908.

cent.¹ Osler² found the pneumococcus in 8 out of 100 necropsies, Aufrech³ in 7 out of 253 necropsies, and Pearce⁴ in 2 out of 121 necropsies on cases of pneumonia. Jundell⁵ reports this bacterium in 106 out of 387 cases of acute meningitis. Councilman⁶ reports the pneumococcus in 18 out of 61 sporadic cases of meningitis since 1897, and Libman⁷ in 6, as secondary infections, out of 100 cases of meningitis.

In regard to the question as to the frequency of primary pneumococcic meningitis, it may be stated that infections of this character are extremely rare. The fact that meningitis so rarely occurs in pneumonia, when in most cases the bacteria are in the blood, gives ample proof of the fact that the microorganisms do not possess any special affinity for the meninges, as is the case with *Micrococcus intracellularis meningitidis*. Councilman⁶ reports a series of 28 cases of meningitis due to the pneumococcus, with the possible primary infection in only 3 cases.

There is a difference of opinion as to whether the pneumococcus may cause epidemics of meningitis. Weichselbaum and Netter both believe that this bacterium may give rise to epidemics, and that it is a very frequent cause of both primary and secondary meningitis. Elser and Huntoon,⁸ in their recent exhaustive studies on meningitis, in which they reviewed the work of Schotmüller,¹⁰ do not think that the pneumococcus is capable of inciting an epidemic, and also hold the view that most infections occur secondary to some other pathological process produced in the body by the pneumococcus. It seems probable that those epidemics which have been reported as not being due to *Micrococcus intracellularis meningitidis* were due to bacteria other than the pneumococcus. In the early studies on meningitis considerable confusion occurred in regard to the differentiation of *Micrococcus intracellularis meningitidis*, *Micrococcus pneumoniae*, *Streptococcus pyogenes*, *Streptococcus mucosus capsulatus*, etc., due to inadequate methods.

Pneumococcic meningitis usually occurs secondary to some other infectious process in the body, such as pneumonia, otitis media, mastoiditis, and occasionally in ethmoiditis following natural and operative infections, and in infected wounds following fractures at the base of the skull. In extending to the brain from the ethmoid cells the infection usually passes through the cribriform plate. The case reported by Councilman¹¹ is typical of this mode of infection.

The case of pneumococcic meningitis which we wish to report

¹ Musser and Norris, Osler, *Modern Medicine*, ii, 614.

² *Ibid.*, ii, 559.

³ *Ibid.*

⁴ *Ibid.*

⁵ *Nordiskt. Med. Arch.*, 1901, v, 2.

⁶ *Jour. Amer. Med. Assoc.*, 1905, xlv, 997.

⁷ *Mt. Sinai Hospital Reports*, 1903, iii, 546. Cited by Elser and Huntoon.

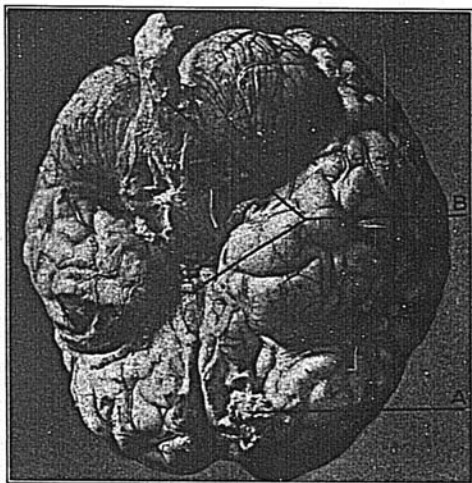
⁸ *Jour. Amer. Med. Assoc.*, 1905, xlv, 997.

⁹ *Jour. Med. Research*, 1909, xx, 532.

¹⁰ *Munch. med. Woch.*, 1905, lii, 1617, 1683, 1729.

¹¹ *Loc. cit.*

is one which was secondary to an inflammation of the anterior ethmoidal cell and an empyema of the frontal sinus. In this case the frontal sinus extended over the right orbit, the frontal bone was eroded over a small area, and the meninges were infected from this point (see figure). There was no evidence of the infection passing through the cribiform plate of the ethmoid which was the most advantageous point of entrance, as was shown by its relation to the inflammation in the anterior ethmoidal cell. The infection evidently passed to the anterior ethmoidal cell from the nares by way of the infundibulum and thence through the foramen into the frontal sinus.



Acute pneumococcic meningitis. A, the point of primary infection over the right orbit; B, the area of basilar meningitis surrounded by greenish-yellow pyogenic exudate.

History. F. F., male, aged eighteen years, white, single, box maker, was admitted to Columbus State Hospital, June 4, 1909, with a diagnosis of acute mania by the physicians signing the commitment papers. The present attack began four days previously. He had one previous attack which lasted six weeks according to commitment papers.

Status Præsens. The patient is in a marked delirium. When pressed with questions he answers them incoherently. The body

is well nourished and the musculature good. The pupils are unequally dilated, the right being completely dilated and immobile. The right upper lid shows marked ptosis and the right eyeball is immobile. All reflexes are exaggerated and the skin is hyperesthetic. The lips are surrounded by herpes, and tongue and teeth covered with sordes. The tongue is heavily coated. The patient's head is drawn to the right and posteriorly. Attempts to move the head in the opposite direction elicit great pain. The back is rigid and shows a slight opisthotonos. There is slight rigidity in the right shoulder joint. Kernig's sign is present in both legs. The skin is cyanotic over extremities and there is a slight petechial rash over both thighs and legs. The bladder is distended; 900 c.c. of dark amber urine was withdrawn per catheter. The respirations are 22 per minute. The respiratory system is otherwise negative except for a slight dyspnoea and slight vesicular breathing. The area of heart dullness is slightly increased. No murmurs are heard. The rate of the heart is 160 per minute. The skin shows *taché cerebrale* and cyanosis. The abdomen is distended and tender on deep pressure. The digestive and genito-urinary systems are negative.

The patient was taken to the operating room at 4 P.M. and a lumbar puncture made for the diagnosis of cause of the meningitis.

The results of the various analyses are as follows:

Urine. Amber, slightly clouded, specific gravity 1026, acid, albumin 1.5 grams to the liter. Few granular and epithelial casts, few polymorphonuclear leukocytes and erythrocytes, mucous threads. Otherwise negative.

Blood. Erythrocytes, 5,760,000; leukocytes, 33,200. Hemoglobin (Sahli), 100 per cent. Differential: large mononuclears, 2.78 per cent., small mononuclears, 4.4 per cent., polymorphonuclears, 92.8 per cent. Few free nuclei.

Cerebrospinal Fluid. Three c.c. withdrawn, clouded; globulin increased. Large numbers of polymorphonuclear leukocytes. Large numbers of Gram-positive diplococci, free and phagocytized. These microorganisms are typical pneumococci, as was shown by capsules and also later by cultures.

Diagnosis. Acute pneumococcic meningitis.

The usual therapeutic measures for the relief of meningeal inflammation were applied. The patient died at 5 A.M., June 5, having been in the hospital seventeen hours.

The necropsy was performed five hours post mortem and showed the following conditions:

Necropsy Report. Rigor mortis is present. The pleural cavity shows numerous fibrinous adhesions over the upper lobe of the right lung. Both lungs are slightly increased in weight and show slight passive congestion. There is a marked increase in the fluid in the pericardial cavity. The heart is normal. Peritoneum is normal.

The liver is distinctly mottled in appearance and shows marked fatty infiltration together with passive congestion and cloudy swelling. The gall-bladder is normal. The spleen shows a slight passive congestion. The kidneys are enlarged, mottled and lobulated, and the cortex thickened. Microscopic examination reveals acute parenchymatous nephritis. The adrenals are slightly congested. The stomach and intestines are distended with gas and show slight passive congestion. The bladder is distended. The mucosa is slightly congested. The genitals are normal.

A detailed examination of the head and spine reveals the following:

The scalp is of normal thickness and strips easily. There is a slight contusion in right frontal region. The calvarium is normal. The brain weighs 1200 grams. The dura is distended, injected, and the convolutions are barely visible. A large amount of fluid escapes on opening the dura. Cultures and slides show *Micrococcus pneumoniae*. The dura is adherent over the orbit in the region of the right frontal sinus. There is an erosion in the frontal bone over the orbit 1.5 cm. to 2 cm., and the opening extends into the sinus. There are marked fibrinous adhesions in this area between the bone, dura, and pia-arachnoid. An inflammatory exudate is also noted. The pia-arachnoid is intensely congested. Fibrinous inflammatory exudate with adhesions is noted along the right olfactory tract to the optic chiasm, back of which the entire base of the brain, including the crura, pons, medulla, etc., are surrounded by the same greenish-yellow, fibrinous exudate. This exudate seems to be limited to the base of the brain, with the exception of the cisterna magna, which contains some exudate, and extends down the cord. The ventricles contain an increased amount of very cloudy fluid. There is a very marked increase in the total cerebrospinal fluid. Pneumococci are very prevalent.

Spinal cord: The dura is adherent to the pia-arachnoid its entire length by means of fibrinous adhesions. The pia-arachnoid is markedly injected. Greenish-yellow, fibrinous exudate is abundant.

Middle ears: normal.

Frontal sinus: The left side is normal, the right side shows an erosion of the frontal bone over the sinus. The right frontal sinus is larger than the left and is filled with inflammatory exudate. It extends well over the right orbit. The mucous membrane is inflamed and necrotic. There is a foramen between the frontal sinus and the anterior ethmoidal cell. This foramen is filled with greenish-yellow exudate. Cultures and slides show *Micrococcus pneumoniae*.

Anterior ethmoidal cell: The left is normal, the right shows a slight amount of inflammatory exudate similar to that noted

in the frontal sinus. Cultures and slides show *Micrococcus pneumoniae*.

Middle and posterior ethmoidal cells: normal.

Sphenoidal sinus: normal.

Nares: normal.

Anatomical Diagnosis. Acute pneumococcic meningitis, empyema of the right frontal sinus, with slight involvement of the anterior ethmoidal cell, acute parenchymatous nephritis, fatty infiltration of the liver, passive congestion of the lungs, liver, kidney, spleen, intestines, etc., pericardial effusion, cloudy swelling of the liver.

Examination of the tissues from the nervous system and discussion of the pathology of pneumococcic meningitis. The base of the brain shows the most marked lesions. The exudate, which is markedly cellular and fibrinous, extends from the anterior portion of the lower aspect of the right frontal lobe back over the optic chiasm, crura, pons, and medulla down the spinal cord. The exudate is almost entirely confined to the base of the brain and extends deep into the sulci. There is no exudate along the longitudinal fissure. There is an intense injection of all vessels. The meninges of the cerebellum are intensely congested, which is quite characteristic of pneumococcic meningitis. The cranial nerves, particularly the third, show evidences of inflammation. The Gasserian ganglion is swollen. The ventricles show an increase of fluid and a slight amount of exudate. The microscopic examination of the tissues shows the following:

The neuroglia in the subpia is slightly increased. This is characteristic of this form of meningitis, especially in those cases lasting from ten to fifteen days, as is pointed out by Southard and Keene.¹² The cortical tissue is infiltrated with polymorphonuclear leukocytes, and large endothelial phagocytic cells, similar to those described by Councilman,¹³ are noted in the region of the blood-vessels. This condition occurs in practically all forms of meningitis. The arteries at the base of the brain show a peculiar infiltration with leukocytes and a pushing up of the intima from the media with the fibrinous exudate. The veins show an infiltration with leukocytes in some places, but no other change in the walls. The cranial nerves and the Gasserian ganglion show a direct extension of the exudative inflammatory process from the brain. The right third nerve shows a slight increase in neuroglia. Changes of this character are said to be most marked in pneumococcic meningitis of long standing.

This case is typical of practically all cases of pneumococcic meningitis. The following points may be noted in regard to this disease:

- (1) Its virulent and fatal character; 99 per cent. of all cases die.
- (2) The greenish-yellow character of the exudate, which is markedly

¹² Jour. Amer. Med. Assoc., 1906, xlv, 13.

¹³ Ibid., 1905, xlv, 997.

cellular and fibrinous in constitution. (3) The polymorphonuclear and endothelial cell infiltration of the cortex of the brain. This change is, on the whole, less marked than in the other forms of meningitis. (4) The increase in neuroglia in the subpia and in the cranial nerves. (5) The infiltration of the walls of the arteries with leukocytes and exudate, causing a spreading apart of the intima and media and in addition the infiltration of the veins with leukocytes.

SEROUS MENINGITIS IN TYPHOID FEVER AND ITS TREATMENT BY LUMBAR PUNCTURE.

By RICHARD STEIN, M.D.,

VISITING PHYSICIAN TO THE GERMAN HOSPITAL, NEW YORK.

THE object of this communication is to draw attention to a symptom complex occurring in the initial stage or during the course of typhoid fever, called by some by the generic name of typhoid-meningitis, and by others the cerebrospinal type of typhoid fever. German authors designate the condition as meningotyphus. These names, moreover, are intended to include cases of true purulent meningitis caused by *Bacillus typhosus*, as well as those cases of typhoid fever with meningeal symptoms in which the serous fluid is found sterile after careful bacteriological investigation by culture, etc. They do not include those cases of cerebrospinal inflammations, during the course of typhoid fever, caused by other than the bacterium of Eberth. The term meningeal irritation, or meningism,¹ is generally reserved for those cases in which an anatomical substratum is supposed not to exist. Meningism is a very popular term with French authors. It is nothing more than a very striking clinical phase of certain infectious diseases occurring in the exanthemas, in typhoid fever, pneumonia, etc. Meningism may usher in these diseases, or it may develop during their course. It usually disappears after a short time. If the case ends fatally, a pathological basis for this condition of meningism or meningeal irritation cannot be found at autopsy.

According to Osler, "Cortical meningitis is not to be recognized by any symptom or set of symptoms from a condition which may be produced by the poison of many of the specific fevers." In other words, meningism and meningitis may be clinically identical.

My own observations comprise three cases observed at the German Hospital, in which a serous exudate was found in the subarachnoid space of the cord by means of lumbar puncture. In one case the

¹ This term was introduced by Dupré. Discussion on this subject in the article by Troisier, *Bull. et mém. des Hôp. de Paris*, xvii, 1900.